Aquatic and Riparian Habitat Assessment for the Eugene-Springfield Area

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Prepared for:

Metropolitan Endangered Species Act Coordinating Team (MECT)
City of Eugene, City of Springfield, Lane County, Lane Council of Governments, Metropolitan Wastewater Management Commission, Springfield Utility Board, Eugene Water and Electric Board, and Willamalane Park and Recreation District

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Introduction

This document was prepared at the request of the Metropolitan ESA Coordinating Team (MECT) which includes representatives from the City of Eugene, City of Springfield, Lane County, Lane Council of Governments, Metropolitan Wastewater Management Commission, Springfield Utility Board, Eugene Water and Electric Board, and Willamalane Park and Recreation District . This project was funded, in part, by a grant from the Oregon Watershed Enhancement Board.

The purposes of this assessment are to:

- Inform local government staff, elected officials and interested citizens about the current condition of key aquatic and riparian indicators relative to historic conditions.

- Assist MECT agencies with preparation of an action plan for habitat conservation, enhancement, and restoration planning for aquatic and riparian resources, and fishes listed under the federal Endangered Species Act.

- Provide preliminary site-specific recommendations for protection, restoration, and enhancement of habitat.

- Identify key gaps in information and monitoring related to these resources.

This assessment includes the evaluation of the following topics:

Physical and historic setting
Physical condition of waters and their associated vegetation
Water quality
Hydrology
Aquatic organisms, including fish, turtles, and macroinvertebrates.
High priority protection and restoration opportunities

The study area includes portions of five fifth-field watersheds (Map 2). The Long Tom River watershed includes streams that flow west and northwest into Fern Ridge Reservoir or directly into the Long Tom River. The majority of stormwater draining from the City of Eugene is routed through this watershed (Map 14).

The Lower Coast Fork Willamette River watershed within the study area includes only the lower 5 miles of the river and the Russell Creek drainage. The Lower Middle Fork Willamette watershed within the study area includes the lower 7 miles of the river, a few small tributaries, and some drainage from the south part of Springfield.

The Lower McKenzie River within the study area includes the lower 18 miles of the river and Cedar Creek, a major tributary of the study area. Much of the stormwater draining from the east one-half of Springfield flows into Cedar Creek and the McKenzie River. The Mohawk River is not in the study area, but it does flow into that portion of the McKenzie River that is included in the study area.

The Upper Willamette/Muddy Creek watershed within the study area includes 12.5 miles of the most upstream portion of the Willamette River and some small tributaries. In addition, stormwater from the west portion of Springfield and the east portion of Eugene is conveyed into this watershed.

A glossary of technical terms used in this document is provided in Appendix A.

1. Geographic Setting and History

The MECT study area includes the cities of Eugene and Springfield, their respective urban growth boundaries, and a few areas outside the urban growth boundaries (Map 1, Map 2). It is situated at a unique crossroads of ecological and social influences.

The Middle and Coast Forks of the Willamette River flow into the south border of the study area and then join to form the Willamette River. The McKenzie River flows from the Cascade Range and forms the northern boundary of the study area until it joins the Willamette River. Both natural and engineered streams flow northwestward through the study area. The largest of these, including Amazon Creek and Willow Creek, are in the Amazon Creek watershed, which is a subbasin of the Long Tom Watershed. Cedar Creek flows for a short distance alongside the McKenzie River on the eastern side of the study area. It is also a significant ecological system in terms of habitat for juvenile spring Chinook and water quality.

The Willamette Valley is a unique, grassland and savanna ecoregion. Its plant and wildlife communities have been influenced by humans from aboriginal Americans to early trappers and explorers, to pioneers and continuing, increasingly, into the present.

1.1 Geology

The landforms of the study area were created over millions to thousands of years ago by a combination of influences including ice ages, volcanism, and cataclysmic hydrologic events. The area is comprised of three major geologic formations (Map 5). One, the basalt geology, is found below the steeper slopes and their rock outcroppings that form the southern boundary of the study area. Specifically, these hills were formed from andesitic basaltic or pyroclastic bedrock formed 10-25 million years ago (Thieman 2000, 14; U.S. Army Corps of Engineers 1953, 4). The second geologic formation is the Missoula flood deposits which consists of that part of the main valley floor buried with silts deposited primarily during the Bretz Floods that filled the Willamette Valley with sediment 12,000-600,000 years ago (Allen et.al. 1986). The third geologic formation is the river alluvium. This is the area within and near the rivers that has been scoured of silts left over from the Bretz Floods and is characterized by coarse sediments and gravel deposited by rivers originating in the Cascade Mountains.

Prior to the geologically recent series of ice ages, 40-50 million years ago, the Willamette Valley was submerged under the Pacific Ocean. Fossil remains of marine mollusks, crabs, and sharks indicate that the climate was tropical (Thieman 2000). From 25-40 million years ago, the Willamette Valley dried as the Coast Range rose from the ocean floor, blocking marine inundation. Two to three million years ago, a series of ice ages sent glaciers stretching south of Seattle (Kettler 1995, 50). Glacial melt water flooded the Willamette Valley, leaving behind till and debris (Thieman 2000). During the Wisconsin ice age, for which there is the best geologic record, sea levels were significantly lower than they are currently as most water was held on land in the form of ice. As the ice started to melt, however, both coastal and inland areas were inundated (Thieman 2000, Allen et.al. 1986).

The most recent significant geologic events that have shaped the Willamette Valley as we see it today are the Lake Missoula Floods, which occurred from 12,000-15,000 years ago. The most recent of these flood events is the Bretz Flood (Allen et.al. 1986). Prior to the Bretz Flood, the Willamette Valley was likely much as it is now, though the valley was likely deeper and the Willamette and McKenzie Rivers larger, roaring with glacial melt from the ice capped Cascades. Flooding from the Bretz Flood began far up the Columbia River Watershed in Montana and Idaho at Lake Missoula. Lake Missoula was an enormous lake formed behind large ice dams created by a glacial finger of the continental ice sheet that extended into northern Idaho. The ice dams broke suddenly and rapidly, allowing 500 cubic miles of lake water to rush out at 60 miles per hour in volumes greater than ten times the current volume of all the rivers on earth (Parfit 1995). This flooding may have occurred a number of times starting 600,000 years ago. The most recent flood event, the Bretz Floods, occurred 12,000 years ago (Allen et.al. 1986).

Flood water roared through Idaho and down the Columbia River, carrying boulders, icebergs, glacial wash, loess, and other materials from as far away as Idaho and eastern Washington down through the Columbia River Valley and into the Willamette Valley. Water was directed through two gaps at Lake Oswego and Oregon City when a hydraulic dam was created between Kalama Gap and Crown Point. Approximately a third of the flow in the Bretz Flood sluiced down the Willamette Valley. In effect, the Willamette Valley was a backwater alcove for the floods. Each flood inundated the Willamette Valley from the Columbia River as far south as Eugene under nearly 400 feet of water. This lake, named Lake Allison, was one of the four temporary major lakes formed by flooding, glacial melt, and impoundment and extended as far south as Eugene. As water flowed farther down the valley, it slowed, leaving larger bedload materials lower in the valley and depositing silts and smaller materials farther south. The Eugene area, at the far end of Lake Allison’s reach, experienced the finest deposition of silts and clays. Most of these depositions reach to the west of Eugene. These silts form the lower parts of the *Willamette Silt* soil type (Allen et. al. 1986).

1.2 Vegetation

1.2.1 Prairie / savannas

The Willamette Valley was originally a wide plain of grassland, prairie, and savanna habitats. The prairie landform varied throughout the Willamette Valley in terms of dominant soil character and terrain. The prairie along and around the Willamette near and just south of Eugene was described as “gravelly” by Walling (1884).

Prairie types can be divided into seasonally wet prairie and dry, or upland, prairie. Seasonally wet prairie areas were located in swales, other depressions, and alongside smaller streams. Hydric conditions during most of the year, particularly through the fall, winter and spring months, create wetland plant associations in these environments. Sloughs and marshes cover extensive areas as side and braided channels of the main rivers change courses each winter. Historically, seasonal wet prairies were located predominantly in the western parts of the study area through the Amazon Creek basin as well as in the Springfield area between the McKenzie and Willamette Rivers (Map 3). This plant community type is rare today in the study area and throughout the Willamette Valley.

Upland prairie areas are situated on higher ground. These grasslands contain many grass and wildflower species which are now rare, including golden Indian paintbrush, white-topped aster, white rock larkspur, Willamette Valley larkspur, peacock larkspur, Willamette Valley daisy, shaggy horkelia, Kincaid's lupine (Titus et.al. 1996). Historically, upland prairie was the predominant cover type of most of the flatter portions of the Study area (Map 3).

Oak savanna and upland prairie vegetation conditions were maintained by fire regularly set by aboriginal peoples (Towle 1982, Morris 1934). Regular burning of open areas favored annuals and perennials and reduced the number of woody plant seedlings that could gain a foothold in the lower elevations. Oregon white oak was the most common tree species within the prairie landscape because it tolerates heavy clay soils and frequent fire. Oak groves were scattered throughout the prairie in isolated pockets of three to four trees or in forest stands extending for a number of square miles (Towle 1982) (Map 3). The Wilkes expedition described the southern Willamette Valley as "wild prairie ground, gradually rising in the distance into low undulating hills, which are destitute of trees, except scattered oaks; these look more like orchards of fruit trees, planted by the hand of man, than grove of natural growth" (Towle 1982, 69).

However, by 1852, as "the country was somewhat settled up and the whites prevented [the Native Americans from burning]", "the hills and the prairies had already commenced to grow up with a young growth of firs and oaks" (Morris 1934, 317). Walling, in 1884, remarks in describing the Willamette Valley as it must have appeared to the pioneers first arriving, "The impenetrable jungle of today at this time was not, the smaller growth being kept low by Indian fires, while the timber land presented an expanse of tempting glades open to movement on foot or on horseback" (335). With the cessation of periodic burning and the introduction of herds of domesticated grazers such as sheep, goats, and cattle, oak savanna and upland prairie habitats declined in area and species composition.

1.2.2 Hillslopes

In 1854, woodland patches and hillslope forests consisted of Douglas-fir (*Pseudotsuga menziesii*), Oregon white oak (*Quercus garryana*), black oak (*Q. kelloggii*), and ponderosa pine (*Pinus ponderosa*) (Towle 1982). Douglas-fir was found on hill tops and within the gallery forests bordering streams and rivers (Map 3). Upland habitats surrounding Springfield and Eugene have changed character since 1850. Walling (1884, 302) describes the hills north of Eugene as being "not high or precipitous, but are most covered with timber of one kind or another, pine and fir being the most plentiful. In some localities large pine trees are scattered over the country and the spaces between them densely covered with an undergrowth of young pine so dense as to be almost impassable for man or beast."

In addition to decreases in acreage, species composition has changed from predominantly oak to Douglas-fir and forest densities have increased because of fire suppression (Titus et.al. 1996). In the late 19th and early 20th centuries, farming and grazing attempts were made on the hillslopes. Sheep ranches were common in the hills surrounding Eugene and Springfield (Walling 1884, 306). However, these proved unsuccessful and abandoned fields were quickly taken over by dense brush. In the mid 1930s, the Oregon State Planning Board advised to allow hillslope farmland to revert to forest (Towle 1982, 84). Although abandoned hillside fields continue to suffer from invasion of exotic brush species such as Armenian blackberry (*Rubus armeniacus*, previously misidentified as Himalayan blackberry) and Scotch broom (*Cytisus scoparius*) to this day, forested acreage on the hillslope of the Willamette Valley has increased.

1.2.3 Bottomland / gallery forest

Bottomland forest occurs on the Horseshoe, Ingram, and Winkle soil types which are all formed in the Missoula flood deposit and alluvial silt geologies (Titus et. al. 1996). The Horseshoe and Ingram are the youngest soil types and are well-drained to excessively well-drained. The Winkle type is well- to moderately well-drained because it contains clay-enriched subsoils. Bottomland forest consists of Oregon ash (*Fraxinus oregana*), Douglas-fir (*Pseudotsuga menziesii*), bigleaf maple (*Acer macrophyllum*), black cottonwood (Populus trichocarpa), red and white alder (*Alnus rubra* and *Alnus rhombifolia*), and willow (*Salix* spp.). These gallery forests bordered the larger rivers (Map 3). The lower Middle Fork of the Willamette also had cedar trees (likely incense cedar, *Calocedrus decurrens*) along it that would eventually provide a source of shingle bolts to settlers (Frost 1978, 43). The associated understory included hazelnut, vine maple, ninebark, and red-osier dogwood. The bottomland forests were proximate to streams, rivers, and sloughs. Low areas within these gallery forests contained wetland species.

The bottoms along the Willamette are heavily timbered with [grand] fir, [big leaf] maple, [Oregon] ash, Balm of Gilead [black cottonwood], and a dense undergrowth of vine maple, hazel, and briers ... there are numerous sloughs that would make the township impossible to survey in the winter (General Land Office Survey T13S R4W, 1852 as cited in Benner 1997).

In 1884, Walling writes poetically about viewing "continuous groves of maple and other kinds of timber marking [the Willamette River's] course as far as the eye can reach" (301) and the "course of the beautiful Willamette may be traced in many a meander…by the dense mass of woods that skirt its banks" (328). Large stands of "cottonwood, alder,…poplar," and Oregon ash grew along the Willamette around Eugene, necessitating that the residents travel upstream several miles to find "good" logs to float down to the local saw mills (Frost 1978, 33).

Although overstory species have not changed in the Willamette Valley bottomlands to a great extent, the width of the gallery forests has. When the original survey was completed in 1854, gallery forests bordering the Willamette River and its tributaries averaged a mile to two miles in width (Towles 1982, 67).

Riparian tree species were harvested continually as settlement expanded along the Willamette River. River reaches in Eugene and Springfield were no exception. Because the rivers offered a way to transport large trees to mills, riparian trees were the first ones logged. Steamboats along the Willamette River consumed large amounts of riparian timber for fuel (Seddell and Froggatt

1984). Western red-cedar was harvested for shingles and fencing, old-growth bigleaf maple was harvested for the furniture trade, cottonwoods were used for barrels and boxes, and white oak and Oregon ash were cut for firewood (Titus et.al. 1996).

Despite periodic harvest, the bottomland forests largely persisted until the early 1900s. Just before the start of the 20th century, the demand for softwood pulp increased dramatically for paper production. The proximity of the gallery forests to the water ways that transported the logs to the mills made them the first to be cut (Towle 1982, 81). In addition, the floodplain soils were better suited than the prairie soils for orchard, vegetable, and fruit crops. Consequently, intensive farming replaced the bottomland forests. As agriculture and transportation spread through the Willamette Valley in earnest, development of streamside reaches, marshes, and wetlands, and installation of drainage tile, irrigation, and flood control measures contributed to the demise of the river bottom gallery forests. Forests were replaced with or divided into smaller stands by agriculture. Remaining hydric bottomland areas were reduced to smaller, drier, disconnected patches. By the 1950s, managed crops or upland and invasive species had replaced most of the study area's riparian forests.

1.3 Streams and Waterways

1.3.1 Streams

Amazon Creek

Amazon Creek begins at its headwaters from springs on the basalt slopes of Spencer Butte, flows through Eugene through Missoula Flood sediments, and drains into the Fern Ridge Reservoir. Before the reservoir was constructed, Amazon Creek drained directly into the Long Tom River. Along the way, its historic channel and hydrology has been dramatically altered by engineered approaches designed to reduce flood effects. As a result of channelization activities, Amazon Creek now splits into the Amazon Creek Diversion Channel north of 11th Street and slightly west of Danebo. Amazon Creek is confined by urban development and heavily affected by urban stormwater inputs from Spencer Butte until it reaches the western edge of Eugene. At this point, though not as affected by stormwater inputs, most of the channel length remains heavily confined and disconnected from the floodplain. Recent restoration activities, however, have attempted to reconnect Lower Amazon Creek with its floodplain. The Lower Amazon Restoration Project that is within the West Eugene Wetlands area is one such example.

Historically, the headwaters of Amazon Creek were small, likely intermittent streams and springs surrounded by pine and Douglas-fir hillslope forests and Oregon ash flats. Once Amazon Creek reached the valley floor, it likely meandered between slough and wetland type systems through bottomland valley forests and seasonal wet prairies (Alverson 1993, Salix Associates 2000). It frequently overflowed its banks during the winter months. James Collins writes "Between Spencer's Butte and [Skinner's] cabin, Coyote Creek [now called Amazon Creek] widened into a shallow lake, more than a half mile across; but it was frozen over, I thought, solid enough for me to cross it" (Collins 1846, as cited in Thieman 2000, 31). Prior to management by the City of Eugene, Amazon Creek was a shallow creek and slough no more than 5 or 6 feet deep upstream of Jefferson [Street]. The banks were moderately sloped, and the peak storm discharges during heavy winter storms resulted in almost annual flooding in what are now South Eugene High School, Amazon Park, Civic Stadium, and the south part of the downtown area (Long 1992, as cited in Thieman 2000, 40).

Because the reaches of Amazon Creek above the County Fairgrounds were not mapped on the original land survey, they were likely intermittent, summer dry channels, much like some of the remaining natural channels in the Willow Creek system are today. During winter months, the Lower Amazon Creek system was frequently connected by flood flows with the Willamette River (Alverson 1993).

Willow Creek

Willow Creek is a summer dry channel system flowing west of and into Amazon Creek just north of West 11th between Beltline and Danebo. Historically, Willow Creek and Amazon Creek joined at what is now the north end of the Spectra-Physics facility (Alverson 1993). In the 1850s, Willow Creek flowed through primarily flat prairie scattered with a few large oaks. Its sloped headwaters were surrounded by oak savanna.

The Willow Creek system, according to General Land Survey Office notes, had very few distinct channels. Low areas, or swales, were dry in the summer and flooded over large areas in the winter (BPA 1995).

Within the area of the lower reaches of Willow Creek north of West 18th, a large log pond was created between 1952 and 1960. The pond was abandoned and filled in the late 1970s. At about the same time, the lower reaches of both branches of Willow Creek, between West 18th and West 11th Avenues, were relocated by the property owner into a single, straight trapezoidal channel (Alverson 1993).

Cedar Creek

Cedar Creek is a tributary of the McKenzie River. Starting at the Cedar Flat area, water is diverted into Cedar Creek from the McKenzie River and it then flows eight miles through the floodplain of the Thurston area, forks into North and South Cedar Creeks, rejoins, and then flows out into the McKenzie through two miles of braided channels. The diversion of a portion of the McKenzie River into Cedar Creek is one of the oldest water rights on the McKenzie River. This diversion provides landowners with irrigation water and helps maintain minimum flows necessary to maintain habitat for fish and aquatic life (Ferschweiler 2002).

Cedar Creek has been utilized as a stormwater runoff channel since flood control became an urban management concern. As early as 1979, residents observed increases in winter flood levels as natural channel flows were augmented by drainage contributions (Brown and Caldwell 1979).

Cedar Creek drains into the McKenzie River just upstream from the City of Eugene's water supply intake (Ferschweiler 2002) so the quality of water coming from Cedar Creek is of considerable interest to the Eugene Water and Electric Board.

1.3.2 Engineered waterways

Springfield Mill Race

The Springfield Mill Race was constructed in 1852 by Elias and Issac Briggs to direct water flow to a log mill that was under construction. They hand deepened and extended an existing backwater slough to bring water from the Middle Fork of the Willamette River in to Springfield's newly developing mills. The Mill Race exits the Middle Fork west of Clearwater Lane and flows northwestward up toward Jasper Road and the Union Pacific railway. It parallels the railroad until it exits into the Willamette River just upstream from the 126 Bridge. The original mill pond near the downstream end of the Mill Race near Island Park was created in the late 1800s (Donald 2000). This area is no longer a pond. The current mill pond is located further upstream of the confluence near the Rosboro Lumber Company yard. Most of the upper portion of the Mill Race retained its natural slough features (Figure 1). The lower half of the Mill Race is the more intensively managed portion.

Figure 1. The upper Springfield Mill Race, 1907 (Courtesy of the Oregon Collection, University of Oregon Library).

Nine out of ten interviewees involved in the Springfield Mill Race Oral History Project identified the Mill Race and the mill pond as important fish waterways (Donald 2000). Quite a few had fished the Mill Race for cutthroat and salmon. One respondent, who at one time worked security at Georgia-Pacific, had to patrol the fish ladder on the Mill Race once an hour at night to keep salmon poachers out. Others reported that the "pond monkeys" working at the mill pond would commonly spear salmon with their pikes to take home for dinner (Donald 2000). Many respondents of the same oral history project also remembered swimming in and picnicking beside the Mill Race in their youth.

Georgia Pacific donated the Mill Race to the city of Springfield in December 1985 (Donald 2000). Recently, the Eugene-Springfield Metropolitan Area Public Facilities and Services Plan determined that it is a functional and usable drainage facility for the city's stormwater (MAPFSP 1999).

Eugene Mill Race

The Eugene Mill Race was constructed in 1851/1852 by Hilyard Shaw and William (or Avery) Smith to power the first Eugene saw mill. They took advantage of two pre-existing sloughs on Mr. Shaw's land claim to facilitate the excavation (Rees 1975). As Bishop (2001) reports, industries, including a distillery, furniture factory, tannery, cider and vinegar factory, woolen, grist, and lumber mills, and a sash and door factory sprung up alongside its ready source of power. In 1887, the Eugene Electric Company built a generator on it. Figure 2 illustrates the flow of the Mill Race near 1910, including the industrial area to the west.

In 1890, a flood destroyed the intake point and changed the course and bed depth of the Willamette which decreased the flow of water through the Mill Race (Rees 1975). After industry stopped depending on the Mill Race for power and subsequent floods continued to damage the intake, it was neglected and even ran dry in 1945.

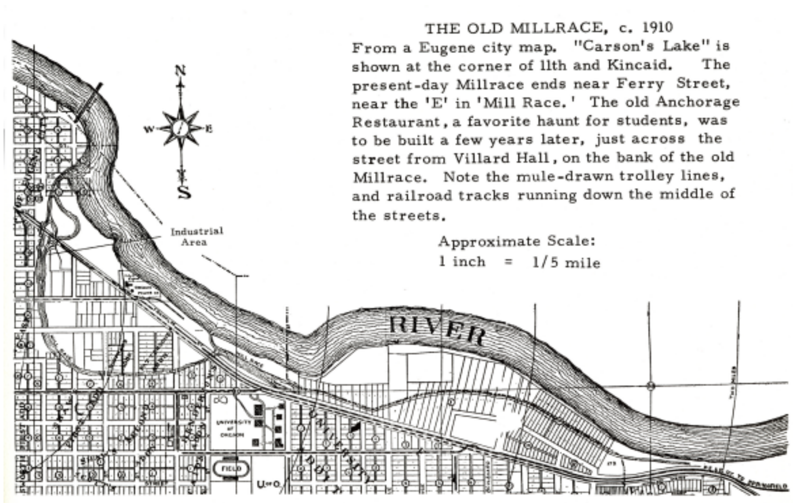


Figure 2. Map of the Eugene Mill Race ca. 1910 (Courtesy Oregon Collection, University of Oregon Library).

The last six blocks of its length were buried under a road improvement project in 1949. In 1952, it was described as a "half-filled muddy slough, clogged with debris." In 1959, pumps were installed to pump Willamette River water into the Mill Race. Despite the pumps, flow remained slow and urban pollutants continued to pour into the water and settle in its sediments. Pollutants at the time included large objects such as furniture and boxes; smaller objects such as cans, bottles, and containers; low dissolved oxygen; stagnant flows; *E. coli;* petroleum; and stormwater runoff and its constituents (Rees 1975). Through the 1960s and into the present, the

Mill Race has remained a controversial feature, with planning decisions that remain torn between historical appreciation, ecological concern, taxpayer expense, and development ease.

1.3.3 River geometry

The combination of a broad floodplain, deep, erodable soils deposited from the Bretz Floods, and large amounts of bedload carried in from the upper watersheds of systems like the McKenzie River and Coast and Middle Forks of the Willamette River, created a historically highly sinuous and braided Willamette River.

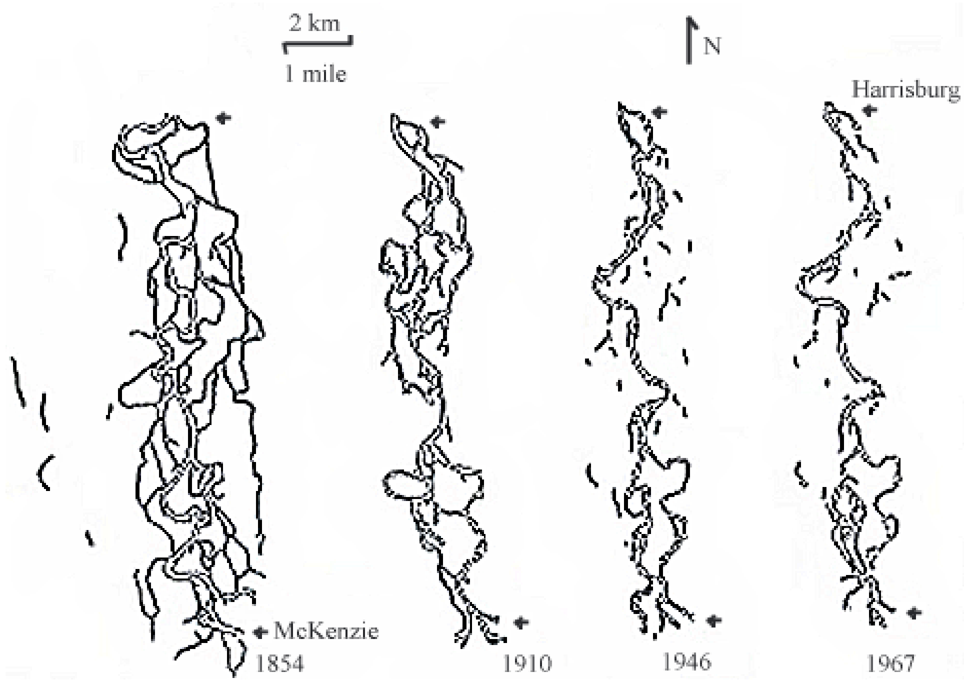
Sinuosity is a reflection of the erosive and dynamic nature of streams and rivers operating in unconstrained valley bottoms. A sinuous river is one that moves laterally by eroding one side of a bank while depositing sediment and building a bank on the other. Sinuous river channels also force the development of side channels and alcoves as the moving river bed separates old channels from newly developing ones or closes off side channel ends through deposition. The complexity of these systems connects the riparian area more closely to the stream by extending the length of riparian edge directly exposed to river processes. The U.S. Army Corps of Engineers wrote in 1875 (as cited in Brenner 1997):

> Each year [upper Willamette] channels are opened, old ones closed, new chutes cut, old ones obstructed by masses of drift; sloughs became the main bed, while the latter assume the characteristics of the former…the formation of islands and bars is in constant progress…only to disappear at the very next high water. Captain Miller, one of the oldest and most experienced pilots in shoal waters of the same nature as the Willamette, has stated that he has never run the same channel for two consecutive years between Harrisburg and Eugene City.

This degree of continual movement and change exemplifies a functioning Willamette River system. Material is removed from one section and deposited elsewhere. Trees and organic material are pulled into the system, incorporated within the river's nutrient cycles, and then deposited elsewhere to provide structure for aquatic and riparian ecosystems. As the Corps noted, sloughs, islands, side channels, and gravel bars are intrinsic parts of what defines the Willamette River. However, these features contributed to the reported difficulty in navigating and managing log drives on these rivers.

From the perspective of a river boat captain or farmers working on land next to rivers, sinuosity meant unpredictable conditions, erosion, fallen trees, and loss of land. Therefore, cities, like Eugene and Springfield, interested in attracting the commerce associated with boat traffic and successful farms, constructed wing dams to focus water flow into a main channel and riprap to harden banks and make them less susceptible to erosion.

Efforts in the late 1800s and early 1900s to remove snags and other obstructions and confine the center channel were considerable. Figure 3, from Sedell and Froggart (1984) and obtained from Brenner (1997), illustrates the loss in sinuosity and channel complexity in the Willamette River from 1854 to 1967 between the McKenzie River confluence and Harrisburg that resulted from this management.



<u>Figure 3</u>. Loss of Willamette River channel complexity from 1854 to 1967 between the McKenzie River and Harrisburg, Oregon. (Sedell and Froggart 1984).

Over the century, total main channel length in the Willamette River (downstream of the McKenzie River) was reduced to 45-50% of what it once was (Brenner and Sedell 1997) and many side channels were eliminated.

The federal government legislated the ongoing channel modifications with the Flood Control Act of 1950. This empowered the U.S. Army Corps of Engineers to authorize "necessary channel clearing and snagging" and construction of bank revetments. From 1948 to 1951, 7419 feet of stone revetments were installed along the Middle Fork of the Willamette (U.S. Army Corps of Engineers 1953, 14).

In 1951, the City of Eugene constructed a rock wing dike to attempt to control bank erosion between River Mile 184.1 and 184.8. It was ineffective. The U.S. Army Corps of Engineers concluded in their analysis that the diversion dam used to maintain a head for the Mill Race has been a contributing factor to the erosion within this reach (1953). Proposals to minimize the effects of flooding by the Army Corps of Engineers included channel closures, bank hardening for over 1300 continuous feet, raising river side roads to serve as a levee, and constructing levees. Bank hardening and other flood modifications for reaches downstream of Eugene were not included in the analysis because the McKenzie River reservoirs were not in place and their effects on flows could not be anticipated (U.S. Army Corps of Engineers 1953, 36).

In 1959, Soil Conservation Service (SCS) construction plan design diagrams for the Q Street Floodway indicate that the High Banks Dike along Maple Island Slough on the McKenzie River was constructed by Lane County.

"Most of the revetment construction has been along the outside banks of river bends, the locations where the channel is most active in lateral cutting and moving. Channel constraint has ecological consequences, because river channel migration within the valley floor creates off-channel aquatic zones and gravel bars for cottonwood stands, and delivers large wood to the channel from the banks" (Benner 1997).

1.3.4 Gravel mining

Sometime after 1936, gravel operations began on the Middle Fork of the Willamette River just upstream of the confluence with the Coast Fork and in the Willamette River near downtown Springfield. Gravel companies began mining gravel in the Willamette River / McKenzie River confluence area in the late 1960s. Initially, mining was of the bars and beds of the river. Currently, mining is mostly of the land adjacent to the river. Dikes are maintained between the pits and the river to avoid adding turbid water to the river. Some pits are mined deeply (up to 130 feet deep) and, therefore, kept free of water by continuous pumping. Sites with a shallow gravel deposit (up to 25 feet deep) are mined with the water in the pit. Most areas that have been or are currently being mined were occupied by the main channel of the river within the last 70 years (Andrus et al. 2000).

Delta Ponds is an abandoned gravel extraction site with numerous shallow gravel pit ponds that were constructed from the 1940s through the 1960s. The area is now owned by the City of Eugene. The Corps of Engineers will soon release a plan for providing water connection among ponds and the Willamette River, reducing areas of exotic aquatic plants, and improving fish habitat.

1.3.5 Navigation

Even in the mid-1800s, when navigation on the Willamette River was difficult during all but high flows, the river had clearly become the vital link in the valley's transportation system. During fall, winter and early spring, it was the only continuous highway between the upper valley and Portland because the valley floor would become impassable with mud (Foster 1978, 24). However, even at high flows, logs, drift, and heavy sedimentation made river travel hazardous.

> The Willamette River had risen…so high as to render it unsafe and risky to venture with boat into the channel, owing to the number of floating logs and large trees displaced from the banks. The water was so thick with mud as to render it impossible to discern the positions of snags below its surface (U.S. Army Corps of Engineers, 1875 as cited in Benner 1997).

Though most experienced river boat captains believed that the Willamette was too shallow for travel south of Corvallis, in 1854 one adventurous steamboat captain piloted the "Fennix" to Harrisburg "to prove that it could be done." River depth south of Corvallis was unpredictable depending upon winter and spring freshets from rain and melting Cascade snows (Frost 1978, 25). The very first boat to reach Eugene on the Willamette arrived in March, 1857, after a three-day trip from Corvallis dodging mudflats and sunken logs (Foster 1978, 26). By the late 1800s, Eugene and Springfield were regularly accessible by boat at high water stages. The Ferry Street Bridge at Eugene was considered the head of navigation.

In recognition of the need to improve and streamline the Willamette's use as a transportation conduit, the first federal project to improve navigability on the stretch of Willamette between Oregon City and Eugene was initiated in 1870 (Brenner and Sedell 1997). Techniques applied to improve navigation on the river include:

- Depositing dredge spoils at the heads of side channels
- Filling in side channel mouths and "useless sloughs" with trees and drift
- Constructing "closing dams" or "cut-off dams"
- Scraping "shoal bars"
- Installing "water-contracting low dams" to sluice the river bed and deepen flow
- Removing of snags and other channel wood
- Installing of stabilizing revetments to prevent lateral channel migration (Brenner and Sedell 1997)

It became critical to remove the large trees blocking passage and close side channels and sloughs to simplify navigation. Between about 1880 and 1950, the agency removed over 69,000 snags from the channel and overhanging trees from the river banks (Benner 1997). Army Corps of Engineers also built "wing dams" to direct flow into the center of the Willamette main channel or to close off a side channel (Figure 4).

Figure 4. Skinners Bar dam, built in 1898-99 down river of Eugene. The dam served to cut off the head of a side channel and to direct water into the main channel of the Willamette (U.S. Army Corps of Engineers, 1899, as cited in Brenner 1997).

1.3.6 Log transport

Some of the earliest alterations to the natural river systems in the MECT study area were related to supplying mills with water for power and log transport. The log drives that supplied the mills with timber also affected channel shape and flow. By the 1870s, log driving "was common practice" on the McKenzie and Willamette Rivers, including the Middle and Coast Forks. One of the biggest log drive fiascoes occurred in 1871, when the Laird brothers contracted to drive five million board feet of sugar pine logs down the Middle Fork of the Willamette from Fall Creek at Pine Openings to the Eugene City Mill. The Laird brothers did not realize that sugar pine floated poorly and all five million board feet sank up in the higher reaches of the Middle Fork (Frost 1978, 38).

In the early 1900s, several large log drives were moved down the Middle Fork Willamette River. Millions of board feet of timber would be driven down in separate log drives that had to be coordinated. When they were not or when flows fell before the drive was done, logs were left stranded or drivers resorted to using powder kegs to blow jams out (Frost 1978, 46). In 1903, there were "no less than 35,000,000 board feet of logs" in the Middle Fork to supply the various mills in Eugene and Springfield (Frost 1978, 49). Farmers and river-side residents complained about the force of the logs slamming into the river banks and accelerating erosion. In 1912, the construction of a railway up the Middle Fork brought an end to the log drives (Frost 1978, 67).

1.3.7 Land drainage

Land drainage did not become an issue of concern until the cities of Eugene and Springfield had grown enough where annual flooding of urban streams became a nuisance.

Situated between the McKenzie River and the Middle Fork Willamette River, and built around a natural spring area, Springfield required urban drainage as it grew. The city took advantage of its available natural drainage features and constructed others to correct flooding problems. The four major drainage water courses in West Springfield are the McKenzie River, the Willamette River, the Mill Race, and the Q Street Ditch (Floodway) (Kramer, Chin and Mayo, Inc. 1983). In a 1979 analysis, hydrologists reported that East Springfield utilized open ditches to direct water into the McKenzie River and Cedar Creek. Most major storm sewers and drainage channels were constructed in the 1960s (Brown and Caldwell 1979).

The existing Q Street Floodway was completed in 1962 by the SCS to handle drainage for most of central western Springfield (SCS 1962). At the time of construction, an open ditch called the McKenzie ditch ran through the center of Springfield from east of 25th Street up to Mill Street where it joined with the initial Q Street Floodway (SCS 1962). It was abandoned with the construction of the Q Street Floodway. The far western portion of the Q Street Floodway that runs underneath I-5 and into the Patterson Slough area already existed prior to 1962.

After construction, small ditches and drain pipes drained into the channel from surrounding areas. Larger open channels including the I-5 Floodway, the SCS Channel No. 6 and an irrigation canal near Marcola Road continue to drain directly into it. The I-5 Channel drains approximately 325 acres. The SCS Channel 6 was constructed by the SCS in the 1960s and drains 540 acres. The Marcola Road irrigation channel drains 450 acres. In addition to this combined 1315 drainage acres, the Q Street Floodway also has its own drainage area. The Lower Q Street Floodway area drains 970 acres and the Upper Q Street Floodway drains 750 acres. A 1200-acre drainage area (formerly called the Willamalane drainage area) empties into the Q Street Floodway through a pipe just west of 5th Street. The total drainage area affecting the Q Street Floodway is approximately 4235 acres (Kramer, Chin and Mayo, Inc. 1983).

The 1983 West Springfield Drainage Master Plan recommended that, though most small cross country and road side ditches be phased out and piped, the larger open ditch systems including the Q Street Floodway, the 1-5 Floodway, the Mill Race and the SCS Channel No. 6 be left open.

In 1912, the City of Eugene authorized ditching on Amazon Creek. In 1925, it was widened between 15th and Jefferson Street to 17th and Pearl Street (Thieman 2000, 40). Major stormwater and flood management occurred on Amazon between 1951-58, when the U.S. Army Corps of Engineers constructed the A-3 diversion channel to Fern Ridge reservoir, widened the channel from 17th and Pearl Street up to 33rd and Hilyard Street, and constructed the concrete channel between Jefferson Street and 24th Street (Thieman 2000). These flood mitigation efforts were successful in reducing the frequency of floods and has allowed development to increase in this area of Eugene.

1.3.8 Reservoirs

Though outside the study area, 8 major reservoirs on the McKenzie, Middle Fork, and Coast Fork of the Willamette Rivers have a large influence on the rivers and their aquatic organisms that flow through Springfield and Eugene. The dams were constructed over a 25 year period, beginning in 1942 and ending in 1966. The reservoir projects were built, in part, to protect downstream areas from flooding and to generate electricity for the region. They were also built to supplement flow in downstream waters for purposes of summer irrigation and pollution dilution. Though not originally designated for this purpose, the reservoirs are also managed for boaters, fishers, and other summer recreationists. Power producing capacity of each of the 8 reservoirs upstream of the MECT study area is provided in Table 1a.

Table 1a. Power producing capacity of reservoirs upstream of the MECT study area

Reservoir	Basin	Power-producing capacity (kW)
Cougar	McKenzie	25,000
Blue River	McKenzie	None
Fall Creek	Middle Fork Willamette	None
Hills Creek	Middle Fork Willamette	30,000
Lookout Point	Middle Fork Willamette	120,000
Dexter	Middle Fork Willamette	15,000
Dorena	Coast Fork Willamette	None
Cottage Grove	Coast Fork Willamette	None

McKenzie River reservoirs

Cougar dam is on the South Fork of the McKenzie River approximately 42 miles east of Eugene. It was completed in 1964. It is the highest embankment dam ever built by the Army Corps of Engineers and sits 452 feet above stream bed. Blue River dam is on the Blue River tributary, 38 miles east of Eugene. It was completed in 1969, partially in response to the devastating floods of 1964. Blue River reservoir is usually drawn down in the summer sooner than Cougar reservoir so recreation use is greater at Cougar reservoir.

Middle Fork of the Willamette River reservoirs

Fall Creek dam is located on the Fall Creek tributary, 22 miles southeast of Eugene. It was completed in 1966. Hills Creek dam is located on the Middle Fork Willamette River, about 45 miles southeast of Eugene and was completed in 1961. Lookout Point dam, also located on the Middle Fork, is approximately 22 miles southeast of Eugene. It is 26 miles downstream of Hills Creek dam. It was completed in 1954 and creates the second largest reservoir in the Willamette basin. Dexter dam is on the Middle Fork and is 2.8 miles downstream of Lookout Point. It serves as a re-regulating reservoir for Lookout Point. It was completed in 1954.

Coast Fork of the Willamette River reservoirs

Dorena dam is on the Row River tributary and is 6 miles east of Cottage Grove. It was completed in 1949. Because of its small size, it is not usually drawn on during the summer months to augment Willamette River flow.

Cottage Grove dam is on the Coast Fork Willamette River about 6 miles south of Cottage Grove. It was completed in 1942. Like Dorena dam, Cottage Grove dam is also small so is not often drafted for flow to the Willamette River.

The physical and ecological consequences of these dams on downstream areas are discussed in later sections.

1.4 Disturbance Patterns

1.4.1 Fire

Fire was a common occurrence in the Willamette Valley and surrounding mountain ranges and surely affected the prairie areas within and around the study area. Early settlers and explorers report that Willamette Valley fires were annually set by native Americans. Jesse Applegate, who lived near Dallas, Oregon, reported that "We did not know that the Indians were wont to baptize the whole country with fire at the close of every summer; but very soon we learned our first lesson" (Morris 1934). During his travels through the west side of the Willamette Valley in September and October 1826, which were ill-timed, for immediately after the late summer burns, David Douglas made frequent reference to "charred stubs of brush" throughout the valley that left his feet sore and little food for his horses or game (Morris 1934). Douglas described the valley north of Eugene as comprised of "solitary oaks and pines interspersed through it…having all burned and not a single blade of grass except on the margins of rivulets to be seen" (Morris 1934). Morris (1934) quotes Douglas as stating

> Some of the natives tell me [fire] is [set] for the purpose of urging the deer to frequent certain parts to feed, which they leave unburned, and of course they are easily killed. Others say that it is

> done in order that they might the better find wild honey and grasshoppers, which both serve as articles of winter food.

The fire regime of the Willamette Valley ecosystem was reflected in its plant and wildlife communities. Native Americans used fire to increase deer and other wildlife, promote food plants and their harvest, and to increase the ease of traveling (Thieman 2000, Morris 1934).

Other than annual burning by native Americans, historic records do not mention the occurrence of catastrophic fires in the Eugene-Springfield area as frequently as they do in the north end of the Willamette Valley or in the Coast Range Mountains. This could partially be a factor of population differences between the two areas, both in terms of frequency of accidents that ignite fires and number of observers to report them. However, on September 7, 1902, a fire started in the Tillamook area and strong winds swept it toward Portland and by the 11th most areas around Portland were burning. By September 12th, the fire had reached the Corvallis area, and on September 13th, it was reported that Skinners Butte was invisible from Eighth Street because of the density of smoke. Clearly, large areas in the surrounding vicinity of Eugene-Springfield burned during this time (Morris 1934, 335).

1.4.2 Flooding

The Willamette River experienced at least five major floods in the 1800s prior to the 1861 flood (Brenner 1997). The 1861 flood was the largest event since Euro-American settlement for which the flow has been calculated. The 1861 peak flow was estimated at 340,000 cubic feet/second (cfs) at the Albany gage (Brenner 1997). At the mouth of the Middle Fork Willamette River, the discharge 112,000 cfs and, at Eugene, the Willamette River was 170,000 cfs (U.S. Army Corps of Engineers 1953, 9). The 1861 flood was the most severe of the 1851, 1861, and 1881 floods (Walling 1884, 337). “There were at least four feet of water over the entire valley, which carried away fences, houses and stock, and caused a general havoc” and “the streets of Eugene City could be navigated with boats and rafts.” During the 1881 flood, “a huge raft of trees and logs [struck] the supports of the northern approach [of the bridge at the town], the piling gave way and the means of access to the bridge was carried down the stream” (Walling 1884, 337). The streets in Eugene were “impassible” and “half the sidewalks afloat.” In Springfield, the west side approach to the Springfield bridge was carried away and the mill dam was broken (Walling 1884, 338).

A flood peak in 1881 was 266,000 cfs at the Albany gage. Records from that year by the Army Corps of Engineers recorded “*The river experienced during the winter and spring [1881] two very prominent freshets, and three moderate ones. The one which caused the greatest damage... [was] the result of heavy snows in the Willamette Valley, followed by long continued warm rains, and reached its maximum on the 16th of January…* (U.S. Army Corps of Engineer 1881, as cited in Brenner 1997).

A sudden freshet rushed down the Coast and Middle Forks and flooded the Willamette on May 29, 1912. New fish racks had just been installed above the McKenzie River and these were carried away, allowing thousands of fish to “escape” up into the upper Willamette system. R.E. Clanton, Master Fish Warden, writes in his report that “the flood came so suddenly and so mightily, having reached a stage of nine feet within 24 hours, that it carried huge trees and other large drift down the river, sweeping everything before it". Subsequent heavy freshets occurred on June 15 and in early September. Mr. Clanton remarked that records indicated that flows during these freshets were higher than in previous years (Biennial Report of the Department of Fisheries 1913).

In 1953, the U.S. Army Corps of Engineers published a plan for work within what is now the study area to mitigate flow effects from reservoir releases on the reaches of the Middle Fork and Willamette within the city. At the time of the report, no reservoirs had been installed on the McKenzie River and within the Willamette system, only the reservoirs at Cottage Grove and Dorena on the Coast Fork had been completed. Lookout reservoir was under construction, Hills Creek reservoir was in the advanced planning stages and Fall Creek reservoir had been authorized, but not planned (U.S. Army Corps of Engineers 1953, 31).

A flood in December 1964 was the first major flood to affect the Eugene-Springfield area after most of the reservoirs had been built; 10.30 inches of rain fell in four days. This rainfall level continues to be the local record. The warm rain fell on an extensive low-elevation snow pack throughout western Oregon and produced the second highest peak flow on record for the McKenzie River (57,400 cfs measured at Vida and 72,000 cfs [presumably at Springfield as reported in Brown and Caldwell (1979)]; records began in 1924). The upstream Cougar Reservoir had been completed the year before, but was only minimally effective at moderating a flood of this size. The resulting flood was severe but, because flood control dams were relatively new in the Willamette basin, not much development had yet occurred in the river's flood plains.

When the highest peak flow since construction of all flood control reservoirs occurred in 1996 (30,900 cfs at Vida), much of the new development built in low-lying areas along the rivers was flooded. The 30-year period of reservoir-muted floods had created a false sense of security about building within flood plains. Eugene received 9.14 inches of warm rain during the 1996 flood, and again, a low-elevation snow pack existed throughout the basin and melted rapidly.

1.5 Wildlife

Prior to and during the early European settlement period, gray wolf and grizzly bear inhabited Willamette Valley bottomland habits. Other animals that are gone or declining, but used to thrive in Willamette Valley habitats around the Eugene-Springfield, area are listed in Table 1b.

<u>Table1b</u>. Mammals, birds, amphibians, and insects that are now extirpated or uncommon, but were once common to the Willamette Valley. Habitats include bottomland forests, prairie, wetlands, savannas, and Douglas-fir forests (taken from Titus et.al. 1996). B = bottomland forest, P = prairie, D = Douglas-fir forest, W = emergent wetland, S = savanna.

Species	Common Name	Habitat type
Canis lupis	Gray wolf	S
Ursus arctos	Grizzly bear	S
Odocoileus virginianus leucurus	Columbian white-tailed deer	B, P
Plecotus townsendii townsendii	Pacific western big-eared bat	D
Haliaeetus leucocephalus	Bald eagle	D
Strix occidentalis caurina	Northern spotted owl	D
Pooecetes gramineus affinis	Oregon Vesper sparrow	S
Coccyzus americanus	Yellow-billed cuckoo	B
Empidomax traillii brewsteri	Willow flycatcher	B
Branta canadensis leucopareia	Aleutian Canada goose	P
Grus Canadensis tabida	Greater sandhill crane	P
Agelaius tricolor	Tricolored blackbird	W
Batrachoceps wrighti	Oregon slender salamander	D
Chrysemys picta	Painted turtle	W
Clemmys marmorata marmorata	Western pond turtle	W
Megomphix hemphilli	Oregon megomphix	W
Rana aurora aurora	Northern red-legged frog	W,B
Rana boylii	Foothill yellow-legged frog	W
Rana pretiosa	Spotted frog	W
Megascolides macelfreshi	Oregon giant earthworm	D
Pterostichus rothi	Roth's blind ground beetle	D
Euphudruas editha taylori	Taylor's checkerspot butterfly	S
Icaricia icarioides fenderi	Fender's blue butterfly	S
Speyeria callipe ssp.	Willamette callippe fritillary butterfly	S
Speyeria zerene bremnerii	Valley silverspot butterfly	S

Around the early 1800s, beaver (*Castor canadensis*) were abundant in almost every lake and stream in Oregon (Bailey 1936). In 1811, beaver were reported as "plentiful" around the Willamette River and the Willamette River Valley was considered the "finest hunting ground for beaver west of the Rocky Mountains" (Bailey 1936). This abundance attracted fur trappers and in a comparatively few years of vigorous trapping, beaver became scarce (Bailey 1936). By 1824, they were reported as "now scarce" (Bailey 1936).

Restrictions on trapping began in 1893 when the Legislature, alarmed by the reductions in populations, closed certain counties to trapping. In 1930, an Oregon district forester wrote that "the number of beaver in the state has been reduced almost to the vanishing point and this has affected stream flow, fish, grazing, and erosion to a serious degree. The beaver dams originally held back the run-off on the heads of streams…The dams are now gone. These dams originally formed rearing ponds for the small fish and helped to restock the streams" (Bailey 1936). State-wide closure to beaver trapping occurred in 1937 and beaver conservation and management was handed over to the Game Commission. The Commission's management objectives were to 1) protect property from beaver damage, 2) conserve the "fur resource" and, 3) "to utilize this mammal in water and soil conservation wherever possible" (Biennial Report of the Oregon State Game Commission, 1945-46). Beaver were dead-trapped in the winter to use their fur to help offset the costs of the management plan and to reimburse landowners for property loss. In the summer, beaver were live trapped and transported to "the high reaches of the watersheds throughout the mountainous sections of the state" (Biennial Report of the Oregon State Game Commission, 1945-46). Game wardens observed that, because landowners were compensated for beaver in the winter, many were willing to tolerate beaver damage throughout the summer before reporting the situation to the Game Commission.

Through their dramatic effects on local hydrology and vegetation, beaver can have a significant impact on riparian and aquatic vegetation community structure and succession (Ray et. al. 2001). Beaver require a ready source of woody shrubs and trees for food and to construct their dams and lodges. They also require an area that is hydrologically suited to impounding water behind their dams. Their dams serve the habitat needs of many other plants, animals, invertebrates and fish.

Bailey (1936) reports that, if beaver are desired in particular localities, they can be "baited with favorite food plants, such as the aspen and cottonwood branches". In summer, they feed primarily on green vegetation of aquatic plants or riparian herbs and take down small trees only for the purpose of building. Barnes and Mallik (1996) determined that beaver select woody stems primarily based upon the size of the stem rather than the species of the plant. In their study in northern Ontario, beaver used alder solely for construction and not for food. The authors hypothesized that the alder provided the most suitable diameter material for rapid dam construction. Material selectivity may have an affect on riparian restoration efforts that want to favor certain species for overstory dominance.

Nutria (*Myocaster coypus*) is an introduced species to western Oregon and originated in South America. They were brought to the United States to attempt to revitalize the fur trade by substituting for the dwindling populations of beaver.

Nutria thrive in highly enriched, slow moving water bodies such as runoff canals and polluted holding ponds (Brown 1975). They are highly adaptable and tolerate poor water quality. Nutria can reproduce any time of the year even when food supplies are limited. Nutria consume their body weight in plant material each day. This voracious appetite can have a significant and dramatic effect on the species composition and vegetation cover and biomass of riparian ecosystems (Ford and Grace 1998). Nutria also adversely affect bank stability by burrowing. When population densities are high, this can cause bank failure.

1.6 Pre-Settlement and Settlement Conditions (up to 1900)

The first inhabitants of the Willamette Valley were probably ancestors of those humans that crossed the Bering Strait land bridge from Asia during the Wisconsin ice age, sometime between 70,000 and 25,000 years ago (Allen et. al 1986). When European settlers and explorers reached the southern Willamette Valley, the Kalapuya tribe occupied the area (Thieman 2000).

1.6.1 Timeline since European settlement to 1900

- In 1846, Eugene Skinner settled at the base of a small rounded peak. The small settlement that grew around his claim was called "Skinner's Mudhole" because it was so low (Frost 1978, 3). J.M Ridson erected the first dwelling in the area that seven years later would become Eugene City.

- In 1848, Jacob C. Spores began running a ferry across the McKenzie with a canoe. He obtained a ferry license in 1850 and operated it until 1878 when the bridge was built by A.S. Mille & Son (Walling 1884, 337). Elijah Bristow remarked upon arriving that the "panorama of mountain and vale stretching out" before him from his perch on a "low, rolling ridge, sparsely covered with oak, fir and pine timber, ever since known as Pleasant Hill", reminded him of a "scene in far-off Virginia" (Frost 1978, 3).

- In 1849, Elias Briggs chose his claim because of a "convenient spring of cool mountain water." Locals knew the fenced portion of his claim as "spring-field." When a settlement grew up around this claim, it was given that name (Foster 1978, 4).

- In 1851, Hilyard Shaw and William Smith constructed the first Eugene saw mill and powered it by water from the Mill Race.

- In 1852, Elias and Issac Briggs constructed the first Springfield saw and grist mill. It was powered by a mill race canal that was dug to extend a natural slough from the Middle Fork closer to Springfield.

- In 1852, Eugene, then called Eugene City, was platted and recorded, and in 1853, was established as the county seat (Walling 1884, 336). A large influx of settlers arrived that year from Eastern Oregon by following the Middle Fork of the Willamette down through the Willamette Pass (Foster 1978, 6).

- The University of Oregon, then just a college, was opened in November 1856. Unfortunately, on the fourth night of that first term, the building was burnt "to ashes" (Walling 1884, 338). It was reconstructed, housed the college for another two terms and then, burnt to the ground again at the close of the third term.

- By 1884, Springfield, situated three miles to the east of Eugene, contained "one of the best water-powers in the country", the Springfield wheat mill, and saw mills.

- In 1886, the first water-supply franchise was granted to T.W. Shelton, Charles Lauer and Associates. The first water supply source for Eugene was located at the northeast end of Skinners Butte on the Willamette River (Stone 1986).

- In 1896, the Booth-Kelly company moved into the area. It would grow to be one of the largest of Lane County's sawmills and timber companies and changed what had been up to this time a simple milling and logging industry into an industrial force.

1.6.2 Settlement patterns

Settlements in the Willamette Valley sprung up along the river between the gallery forests and the prairie and between the prairie and the hillslope forests (Towle 1982). Setbacks from streams and rivers were necessary to avoid flooding. However, streams and rivers were primarily avenues for transportation so proximity to them increased convenience. In addition, prairies and bottomland that were naturally moist were settled first because, "it was thought that, during the dry summers, only such lands would be productive" (Walling 1884). Hillslope forests provided wood for construction and fuel while the prairies provided open ground for cultivation and grazing (Towle 1982). Settlers focused the majority of their efforts and impacts on the prairie which was more amenable to clearing and development.

Three factors contributed to the effect of increased forest cover in the Willamette Valley after settlement (Towle 1982). The first is that Willamette Valley settlers concentrated their settlements on the prairie. They cultivated only a small portion of the land they settled and left the rest open to grazing. Later, cultivation actually decreased because of struggles with poor drainage, and many cultivated plots were abandoned to natural succession. The second is that their heavy presence in the prairie caused the native Americans to cease their annual fires that maintained the prairie ecosystem. And, third, because of the availability of open land, timber harvest, especially of hillside and oak forests, was not a major activity until the early 20th century. Bottomland forests were selectively harvested during this period, especially because their proximity to water facilitated transport of logs. However, while this forested area initially shrank, it later increased up to the early 20th century as Douglas-fir and Oregon oak forests encroached on the Valley floor.

Eugene and Springfield sprung from small scale, diversified homestead farms and ranches. Agriculture in the form of crop production of wheat, hops, and other crops on the prairie and vegetables on the floodplains, and animal production of cattle, sheep, and goats on the hillslopes was critical to the survival and growth of the urban centers in the study area. However, it was not until the late 1930s that agriculture became a defining characteristic of the Eugene-Springfield region. The growth of agriculture had the following effects on the local watersheds:

- Introduction of non-native plants and crops
- Lower summer flows due to irrigation
- Installation of revetments along rivers
- Floodplain timber harvest
- Land drainage
- Grazing of cattle and sheep

1.7 Post-Settlement Conditions (after 1900)

Timeline

- In 1900, the Eugene City population was 3236 and the Springfield population was 353. Its exact square mileage is unknown for this year. However, in 1862, when Eugene City was incorporated, its boundaries extended one half mile in each cardinal direction from the four sides of the County Courthouse. In 1864, this area was reduced to 148 acres (Central Lane Planning Commission 1959).

- In 1903, ground was broken for a new electric power plant in Springfield. In 1905, the power plant and a substation in Eugene were sold to the Willamette Valley Company.

- In 1911, the Eugene Electric and Water Board began operations as a public, municipal company after a 1906 epidemic of typhoid fever spread through the city via the city water wells. Power was generated at the Walterville Power Plant and sent to Eugene and Springfield (Stone 1986).

- The grass seed industry began in the southern Willamette Valley in the early 1900s. Initially, crops consisted of clover, vetch, oats, and cheat. However, when perennial ryegrass was introduced in the mid-1930s, the region's grass seed landscape gained a solid foundation (Thieman 2000). In the late 1930s, the federal government subsidized grass seed test plots in the Eugene-Springfield area for use on the eroded hillsides of the Tennessee Valley because its prairie soils were well suited to the crop (Towle 1982, 79). Fire, the management tool of prairie maintenance, was employed to control disease, increase seed yield, and clear fields too soggy for heavy farm equipment. As a result, the grass seed industry had a significant effect upon the economy and ecology of the southern Willamette Valley.

- Grass seed and other crops benefited from the modernization of agriculture that occurred in the 20th century. The availability of tractors, large plows, and pesticides allowed farmers to increase the acres they managed over a season. As a result, land in the river-alluvium geology surrounding Eugene and Springfield was increasingly tiled and drained to meet the demand for viable fields.

- In 1943, the first flight left the Eugene Municipal Airport. As of September, 2002, the airport currently serves 50 flights daily.

- In 1949, Weyerhaeuser opened its "integrated facility" in Springfield as the first highly efficient mill built without a "teepee waste burner" (Sensel 1999).

- From 1949 to 1966, the U.S. Army Corps of Engineers constructed dams and reservoirs in the upper reaches of the McKenzie River and the Coast Fork and Middle Fork Willamette Rivers.

- In 1950, the Eugene population was 35,879 and the Springfield population was 10,807.

- In the 1950s, the U.S. Army Corps of Engineers began a major push to install revetments along the Willamette River near Eugene and Springfield.

- In 1960, Eugene added a secondary treatment to their sewage treatment facility that drains into the Willamette River. The secondary treatment removed a larger percentage of organic matter from the wastewater before releasing it into the river (Thieman 2000).

- In the 1960s the gravel mining industry began mining gravel along the banks and gravel bars of the Willamette River, its forks and the McKenzie River.

- In 1964-65, a major rain-on-snow event and resulting flood affected the entire Willamette Valley from Eugene to Portland. The flooding in Eugene and Springfield was muted from historical levels because of the reservoirs on the larger rivers.

- In 1979, Springfield developed a master plan for drainage systems in the eastern portion of the city, east of 42nd Street (Brown and Caldwell 1979). In response to continued flooding frequency in West Springfield, a similar master plan was developed in 1983 for this portion of the City.

- In 1992, the City of Eugene and Lane County adopted the West Eugene Wetlands Plan. The Plan was then adopted by the Oregon Division of State Lands and the US Army Corps of Engineers in 1994. It was the first wetland conservation plan of its kind adopted by state and federal agencies in the United States and has since gone into action to create the West Eugene Wetlands Program.

- In 1997, the Eugene population was 123,718 and the Springfield population was 49,430. The combined total area of both cities was 51.5 square miles.

Snapshot - 1960

The following water resource description was obtained from information compiled in the 1959 Eugene-Springfield Metropolitan Development Plan (Central Lane County Planning Commission). In the late 1950s, Amazon Creek was referred to as Amazon Slough. Drainage remained a significant concern in many neighborhoods in both Eugene and Springfield. Identified issues and their neighborhoods are as follows:

Eugene

- Danebo-Bethel - Lack of sanitary sewers was identified as a critical concern.
- Bailey Hill – Subjected to winter flooding. Improvements that included channel lining had just been completed on Amazon Slough and more lining was predicted farther down the channel. City sewers needed to be extended.
- Willakenzie – Flooding remained a problem but the recent installation of controls on Lookout Dam had already begun to help reduce winter levels. Expectations were high for the completion of the Q Street Floodway.
- River Road – Former stream bed channels were still quite evident and there was the expectation that gravel mining would increase.

Springfield

- Game Bird (area between the Pacific Freeway, Harlow Road, and the railroad) – Significant drainage problems. A flood control system was under construction.
- North Fifth Street – Most of central Springfield underwent periodic flooding each winter.

1.8 Summary

The geology of the study area is a result of a series of inundations caused by glacial melting, tectonic uplift, and catastrophic floods. Upland historic vegetation patterns have been heavily influenced by aboriginal disturbances, primarily seasonal fires. Riparian vegetation next to small channels tended to be wetland seasonal prairie. River riparian forests were extensive and primarily dominated by hardwoods. Rivers and streams interacted freely and frequently with their floodplain.

As European settlement increased in the study area, controlling the rivers and channels that seasonally separated settlers from Portland and other northern neighbors became critically important. The Willamette River was dredged and cleaned to facilitate navigation. Sloughs were channeled to bring power in the form of mill races to Eugene and Springfield. Seasonally dry swales and other low areas were channeled to control and divert winter flows through the cities. Eventually, the Willamette's large river tributaries were dammed for hydroelectric power and flood control.

These flow moderation measures and the continued growth of the study area present citizens and planners with the challenge of maintaining and, sometimes, recreating healthy aquatic habitats in a highly altered system. The remainder of this report will examine the current condition of the aquatic systems in the study area and, by considering the findings together, propose recommendations for future action planning to meet MECT management goals.